L15: Entry 1 of 1 File: USPT Jun 2, 1987

DOCUMENT-IDENTIFIER: US 4669745 A
TITLE: Apparatus for controlling steering angle of rear wheels of a vehicle

Detailed Description Text (37):
When the steering wheel 1 is in the central or neutral position, i.e., when the vehicle is running straight, the rear wheel steering judging mechanism I is in symmetry with respect to the vertical neutral axis (shown by one-dot-and-dash line) .circle.A the input shaft 25.

Detailed Description Text (69):
A steering operation during running at high speed causes a large yaw rate, as well as a large lateral acceleration. It is, therefore, possible to control the cross-sectional area of the orifice by making use of the yaw rate or the lateral acceleration as the physical amount relating to the vehicle speed, in place of the vehicle velocity explained before. FIG. 10A shows an example of a yaw rate detector which is used for the purpose of detection of the yaw rate. As will be seen from this Figure, the yaw rate detector is composed of a rate gyro 251 and an electric system 252. The rate gyro 251 is fixed to the chassis 30 at a position of centroid of the latter and is designed for detecting the yaw rate r which is the angular velocity of the vehicle body 30 about a vertical axis. The electric system 252 is adapted to supply a voltage to the rate gyro 251 and to produce a yaw rate signal by amplifying the signal from the rate gyro 251. The yaw rate signal is delivered to the microcomputer 130 as shown in FIG. 8A. The rate gyro 251 and the electric system 252 are arranged such that the yaw rate signal takes a positive value when the yaw rate r is produced by clockwise yaw of the vehicle about a vertical axis in response to clockwise rotation of the steering wheel 1, and a negative value when the yaw rate r is produced by counter-clockwise yaw of the vehicle about the vertical axis in response to counter-clockwise rotation of the steering wheel 1, as shown in FIG. 10B. The microcomputer 130 operates to maximize and minimize the cross-sectional area of the orifice when the absolute value of the yaw rate signal is large and small, respectively, whereby the steer angle of the rear wheel is controlled as in the case of the second embodiment.

Detailed Description Text (142):
FIG. 20A shows the state of the rear wheel steering judging mechanism I and the actuating mechanism attained when the steering wheel 1 is held in the neutral position for keeping the course of the vehicle straight.

Detailed Description Text (143):
In this state, the input shaft 25 is not rotated but is held stationary, so that the coiled spring 1122 is allowed to expand to its full length. In this case, no relative rotation is produced between the pinion 1132 and the pinion 1161 so that the torsion bar 1151 is not twisted. Therefore, the control valve shaft 1151a does not rotate and is held in the neutral position with respect to the rotary valve 1152. Consequently, the power steering fluid 66 supplied from the vane pump 61 is returned to the oil tank 62 through a return port which is formed between the rotary valve 1152 and the conrol valve shaft 1151a. In addition, although the left and right power cylinder chambers 1171L and 1171R are kept under a pressure, no

pressure difference is produced between these chambers because there is no flow of oil. Consequently, no force which would drive the power piston 1172 is produced.

Detailed Description Text (158):
On the other hand, the clockwise rotation of the input shaft 1201 causes the cylinder 1222 to rotate clockwise from the position shown in FIG. 23A, as shown in FIG. 23B FIGS. 23A and 23B are explanatory sectional views. As a result of the clockwise rotation of the cylinder 1222 (direction of arrow in FIG. 23B, the volume of the left cylinder chamber 1222L is decreased to increase the pressure therein slightly, while the volume of the right cylinder chamber 1222R is increased to reduce its internal pressure slightly. In consequence, the working oil 1117 flows from the left cylinder chamber 1222L of the higher pressure to the right cylinder chamber 1222R of the lower pressure, through the groove 1242L, left by-pass conduit 1223L, orifice 1225, right by-pass conduit 1223R and the groove 1242R. This flow of the working oil produces a damping force corresponding to the speed of rotation of the cylinder 1222, such as to urge the vanes 1228, 1229 clockwise, causing the rotor 1227 to rotate clockwise. The clockwise rotation of the rotor 1227 acts to rotate the spur gear 1233 in the same direction through the shaft 1232. When the speed of rotation of the cylinder 1222, i.e., the speed of rotation of the input shaft 1201, is high, a large damping force is produced in the oil damper. This damping force overcomes the resetting force produced by the springs 1214, 1215 and causes a counter-clockwise rotation of the spur gear 1234 through the spur gear 1233, in response to the clockwise rotation of the rotor 1227. As a result, the spur gear 1218 is rotated counter-clockwise to largely twist the springs 1214, 1215. Therefore, when the steering wheel 1 is quickly rotated clockwise, the output shaft 1235 rotates counter-clockwise by an angle corresponding to the rotational displacement angle of the steering wheel, in accordance with the transfer function expressed by the formula (7).

Detailed Description Text (172):
A detection circuit 60 for detecting the rotational displacement of the steering wheel includes a linear resistor 602 and a slider 604 which in combination constitute a linear potentiometer SP fixed to the vehicle body 30. The slider 604 is connected at its one end to a gear accommodated by the gear box 3. A rotation of the shaft 2 in response to the angle .delta.h(t) of rotation of the steering wheel 1 is converted into a linear motion of the gear connected to the slider 604, by means of the motion converting mechanism such as a rack-and-pinion accommodated by the gear box 3. The linear potentiometer SP of the detecting circuit 60 detects this linear motion as a displacement corresponding to the angle .delta.h(t) of steer of the steering wheel 1, and delivers a corresponding voltage signal as a displacement signal D. For the simplification of the description, an assumption is made here that the steering wheel 1 is being continuously operated in the form of sine wave at an angular frequency .omega.. In this case, the angle .delta.h(t) of rotation of the steering wheel is expressed as .omega.t, so that the rotational displacement of the steering wheel from the neutral position, i.e., the position for straight running, is expressed as .delta.h.sub.0 sin .omega.t, where .delta.h.sub.0 represents the amplitude of the steering wheel. In consequence, the displacement signal D delivered by the linear potentiometer SP takes the form of a continuous voltage signal D=D.sub.0 sin .omega.t having the amplitude D.sub.0 corresponding to the amplitude of the steering wheel and having an angular frequency.

Detailed Description Text (183):
The flow rate control valve SV is constituted by a spool valve having a cylinder provided with inlet and outlet ports and a spool which is axially movable in the cylinder. The positional relationship between the spool and the outlet port is changed in accordance with the control signal from the signal processing circuit 1300, so that the area of the restriction is changed to control the flow rate.

CLAIMS:

5. An apparatus for controlling steer angle of rear wheels of a vehicle according to claim 4, further comprising a pinion adapted to be rotated by the operation of said steering wheel, wherein said first and second members are constituted by first and second racks meshing with said pinion in a position of symmetry with each other with respect to said pinion.

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L8: Entry 1 of 5 File: PGPB May 27, 2004

DOCUMENT-IDENTIFIER: US 20040099469 A1
TITLE: Vehicle steering control device

Detail Description Paragraph:
[0043] It should be noted that the gain, Kg in the expressions (1) and (2), may be reduced in response to increasing of an index indicating a degree of turning of a vehicle such as a yaw rate of a vehicle, a rotational position of the steering wheel, etc.

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L8: Entry 3 of 5 File: USPT Sep 1, 1998

US-PAT-NO: 5799745
DOCUMENT-IDENTIFIER: US 5799745 A

TITLE: Device for stabilizing vehicle attitude in terminal portion of countersteering state by reducing vehicle yaw moment produced by yaw moment control mechanism

DATE-ISSUED: September 1, 1998

INVENTOR-INFORMATION:

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ASSIGNEE-INFORMATION:

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APPL-NO: 08/ 659886 [PALM]
DATE FILED: June 7, 1996

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
JP	7-142970	June 9, 1995

INT-CL: [06] B60 K 26/00, B62 D 6/00

US-CL-ISSUED: 180/410; 180/412, 364/424.051
US-CL-CURRENT: 180/410; 180/412, 701/41

FIELD-OF-SEARCH: 180/408, 180/410, 180/412, 180/413, 180/414, 180/415, 364/424.051

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	4679808	July 1987	Ito et al.	180/408
☐	5341294	August 1994	Kanazawa et al.	364/424.051
☐	5365440	November 1994	Abe et al.	364/424.051
☐	5446657	August 1995	Ikeda et al.	364/424.051

☐	5502639	March 1996	Fukunaga et al.	364/424.051
☐	5561603	October 1996	Goto	364/424.051

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
6-270828	September 1994	JP	

ART-UNIT: 318

PRIMARY-EXAMINER: Cummings; Scott

ATTY-AGENT-FIRM: Cushman Darby & Cushman IP Group of Pillsbury Madison & Sutro LLP

ABSTRACT:

A vehicle attitude control device including a yaw moment control mechanism for giving a yaw moment to the vehicle and controlling the yaw moment, and a controller for controlling the yaw moment control mechanism in a normal target follow-up control mode so that the actual yaw rate detected by a yaw rate sensor coincides with a target value determined on the basis of an angle of rotation of a steering wheel detected by a steering wheel angle sensor, and wherein a yaw moment reducing device is provided for reducing the yaw moment to be given to the vehicle by the yaw moment control mechanism, to a reduced value smaller than a normal value to which the yaw moment is controlled in the normal target follow-up control mode. The yaw moment reducing device is operated in at least a second phase of a countersteering period following a first phase which is initiated by vehicle operator's countersteering manipulation of the steering wheel upon slipping of rear wheels of the vehicle during vehicle turning outwardly of the turning direction so as to countersteer the vehicle.

11 Claims, 19 Drawing figures

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L8: Entry 3 of 5 File: USPT Sep 1, 1998

DOCUMENT-IDENTIFIER: US 5799745 A
TITLE: Device for stabilizing vehicle attitude in terminal portion of countersteering state by reducing vehicle yaw moment produced by yaw moment control mechanism

Brief Summary Text (6):
In the vehicle attitude control device of the type indicated above, a control system whose input is the steering wheel rotation angle and whose output is the target yaw rate generally has a first-order time lag, and uses a time constant .tau. in a transfer function describing this first-order time lag control system. This time constant t is a fixed constant value. On the other hand, JP-A-6-270828 discloses a vehicle attitude control device in which the time constant .tau. is a variable which is relatively small when the steering wheel which has been rotated to a given position in one direction and held at that position for some time is further rotated in the same direction, and is relatively large when the steering wheel which has been rotated in one direction and held at the given position is rotated in the reverse direction. The vehicle attitude control device disclosed in this publication is adapted to control the rear steering angle (steering angle of the rear wheels) so that the actual yaw rate of the vehicle coincides with the target yaw rate. When the rotation angle of the steering wheel is increased, the target yaw rate and therefore the rear steering angle will change in quick response to a rapid increase of the steering wheel rotation angle, so that the vehicle can turn with a high response to the operator's manipulation of the steering wheel to turn the vehicle. When the rotation angle of the steering wheel is reduced by rotating the steering wheel in the direction opposite to the direction in which the steering wheel has first been rotated, the response of the target yaw rate and the rear steering angle is relatively low so that the vehicle attitude can be rapidly stabilized or the actual yaw rate of the vehicle can be stabilized with a high response to the operator's manipulation of the steering wheel to stabilize the vehicle attitude.

Brief Summary Text (9):
As indicated in the graph of FIG. 12, the vehicle first enters a "gripping period" during which the tires of the vehicle stably grip the road surface without slipping therebetween and during which the running direction of the vehicle V relatively accurately corresponds to the rotation angle or angular position of the steering wheel, so that the vehicle can turn so as to clear the obstacle B. In this gripping period, the actual yaw rate of the vehicle accurately corresponds to the rotation angle of the steering wheel. The gripping period is defined as a period during which the steering wheel is in a normal steering state.

CLAIMS:

1. A vehicle attitude control device comprising a steering wheel angle sensor for detecting a rotation angle of a steering wheel which is operated by an operator of the vehicle to steer front wheels of the vehicle, a yaw rate sensor for detecting an actual value of a yaw rate of the vehicle, a yaw moment control mechanism for giving a yaw moment to the vehicle and controlling said yaw moment, and a controller for controlling said yaw moment control mechanism in a normal target follow-up control mode so that the actual value of the yaw rate detected by said

yaw rate sensor coincides with a target value of the yaw rate which is determined on the basis of the rotation angle of the steering wheel detected by said steering wheel angle sensor, wherein an improvement comprises yaw moment reducing means for reducing the yaw moment to be given to the vehicle by said yaw moment control mechanism, to a reduced value smaller than a normal value to which the yaw moment is controlled in said normal target follow-up control mode under the control of said controller, said yaw moment reducing means being operated in at least a second phase of a countersteering period following a first phase of said countersteering period, said countersteering period being initiated by countersteering manipulation of said steering wheel by said operator upon slipping of rear wheels of the vehicle during turning of the vehicle outwardly of a direction of said turning so as to countersteer the vehicle, said countersteering manipulation including a rotation of said steering wheel in said first phase so that said front wheels are oriented outwards with respect to said turning direction of the vehicle, and a rotation of said steering wheel toward a neutral position thereof in said second phase.

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L8: Entry 1 of 5 File: PGPB May 27, 2004

PGPUB-DOCUMENT-NUMBER: 20040099469
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20040099469 A1

TITLE: Vehicle steering control device

PUBLICATION-DATE: May 27, 2004

INVENTOR-INFORMATION:

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APPL-NO: 10/ 706096 [PALM]
DATE FILED: November 13, 2003

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	DOC-ID	APPL-DATE
JP	2002-342600	2002JP-2002-342600	November 26, 2002

INT-CL: [07] B62 D 5/06

US-CL-PUBLISHED: 180/421
US-CL-CURRENT: 180/421

REPRESENTATIVE-FIGURES: 3

ABSTRACT:

A new and novel device for controlling a steering characteristic of a vehicle such as automobile so as to enhance an effect of suppressing a change in a behavior of the vehicle body due to a difference between driving and braking forces on the left and right wheels is characterized in that the device makes an amount of controlling the steering characteristic smaller as an index indicating an amount of a shift of vertical loads between the left and right wheels is increased. The steering characteristic is modified through controlling steering assist torque or a steering angle of the steered wheels. The steering assist by the steering control device is fully effective when the vehicle is running on a straight road having surfaces of different frictional coefficients while less effective on a curved road having a uniform frictional surface, preventing undesirable and unexpected modification of

the steering characteristic during turning of the vehicle.

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L5: Entry 1 of 1 File: USPT Jun 2, 1987

DOCUMENT-IDENTIFIER: US 4669745 A
TITLE: Apparatus for controlling steering angle of rear wheels of a vehicle

Detailed Description Text (81):
The motion converting mechanism in the gear box 3, designed for rotating the connecting shaft 21 in response to the rotation of the steering wheel 1, will be described in detail hereinunder with reference to FIG. 13A. The linkage 4 has a rack 3a formed thereon along the length thereof. The rack 3a meshes with a pinion 21a formed on the connecting shaft 21. The arrangement is such that, when the steering wheel 1 is rotated counter-clockwise, the linkage 4 moves to the right as viewed in the Figure, so that the connecting shaft 21 is rotated counter-clockwise, i.e., in the same direction as the rotation of the steering wheel 1.

Detailed Description Text (83):
As will be understood from the foregoing explanation with reference to FIGS. 13A and 13B, the linkage 4 and the linkage 14 are adapted to be moved linearly in opposite directions in response to the rotation of the connecting shaft 21 and the final connecting shaft 28. Thus, the motion converting mechanisms in both gear boxes 3 and 13 are arranged to produce linear motions in opposite directions in response to the same rotary motion.

Detailed Description Text (93):
The operation and advantages of the fifth embodiment incorporating the rear wheel steering judging mechanism II described hereinbefore will be explained hereinunder with reference to FIGS. 14C, 14D and 14E, on an assumption that the input shaft 301 is rotated by an angle .theta..sub.in (t) counter-clockwise, i.e., in the direction of the arrow, in response to a counter-clockwise rotation of the steering wheel 1 by an angle .delta..sub.h (t).

L4: Entry 1 of 1 File: USPT Jun 2, 1987

DOCUMENT-IDENTIFIER: US 4669745 A
TITLE: Apparatus for controlling steering angle of rear wheels of a vehicle

Brief Summary Text (22):
With this arrangement, the damping force of the dash pot is automatically controlled in response to the change in the state of running of the vehicle, in such a way as to automatically adjust the direction and angle of steer of the rear wheels, thus optimizing the running properties of the vehicle. Namely, when the vehicle is running at a low speed, the front wheels and the rear wheels are steered in opposite directions such as to improve the turning performance of the vehicle, whereas, during high-speed running of the vehicle, the rear wheels are steered in the same direction as the front wheels such as to avoid any drastic increase in the sensitivity in response to the steering input, thus improving the steering stability. In addition, when the vehicle is running at a medium speed, the direction of steer of the rear wheels is controlled in accordance with the speed of operation of the steering wheel such that, when the steering wheel is being operated quickly, the steering gain is increased to increase the response to the sharp turning steering input, while, when the steering wheel is being operated gently, the steering gain is decreased to prevent any yaw and oscillation of the vehicle, thus improving the running stability during straight running of the vehicle.

Detailed Description Text (19):
As will be understood from the foregoing description, the direction and the distance of movement of the output shaft with respect to the movement of the first and second members are varied in accordance with the value of the complex frequency. More specifically, according to this form of the invention, the first member is moved in response to the operation of the steering wheel and, at the same time, the second member is moved in the direction counter to the direction of movement of the first member, so that the direction of movement of the output shaft is changed in accordance with the speed of operation of the steering wheel, i.e., in accordance with the value of the angular frequency of movement of the steering wheel, whereby when the steering wheel is being operated at high speed, the rear wheel steer angle is generated in the same direction as the steer angle of front wheels, whereas, when the steering wheel is being operated gently, the rear wheel steer angle is formed in the same direction as the front wheels. When the rear wheel steer angle is generated in the direction counter to the front wheels, front wheel steer angle and the rear wheel steer angle are generated substantially concurrently so that the front and rear wheels produce respective forces. These forces in combination produce a yawing moment which tends to turn the vehicle in one direction, thus producing an effect equivalent to that attained by an increase in the steering gain which is the ratio of angle of steer of the steerable wheel to the angular displacement of the steering wheel. Namely, in this case, the effective steer angle of wheels of the vehicle is considered equivalent to the sum of the front wheel steer angle and the rear wheel steer angle, so that the response to the steering input is improved remarkably. Conversely, when the rear wheel steer angle is generated in the same direction as the front wheels, the effective steer angle of the steerable wheels of the vehicle is equivalent to the difference between the

steer angles of the front and rear wheels, so that the steering gain is decreased to provide a higher steering stability during straight running of the vehicle.

Detailed Description Text (23):
Therefore, according to the invention, the first member is moved in response to the operation of the steering wheel, while the second member is moved in the direction counter to the direction of movement of the first member, thus changing the direction of movement of the output shaft in accordance with the speed of operation of the steering wheel, i.e., the value of the angular frequency of movement of the steering wheel, whereby when the steering wheel is being operated at high speed, the rear wheel steer angle is generated in the same direction as the steer angle of front wheels, whereas, when the steering wheel is being operated gently, the rear wheel steer angle is formed in the same direction as the front wheels. When the rear wheel steer angle is generated in the direction counter to the front wheels, front wheel steer angle and the rear wheel steer angle are generated substantially concurrently so that the front and rear wheels produce respective forces. These forces in combination produce a yawing moment which tends to turn the vehicle in one direction, thus producing an effect equivalent to that attained by an increase in the steering gain which is the ratio of angle of steer of the steerable wheel to the angular displacement of the steering wheel. Namely, in this case, the effective steer angle of wheels of the vehicle is considered equivalent to the sum of the front wheel steer angle and the rear wheel steer angle, so that the response to the steering input is improved remarkably. Conversely, when the rear wheel steer angle is generated in the same direction as the front wheels, the effective steer angle of the steerable wheels of the vehicle is equivalent to the difference between the steer angles of the front and rear wheels, so that the steering gain is decreased to provide a higher steering stability during straight running of the vehicle.

Detailed Description Text (27):
Thus, in this third form of the invention, the control means operates, upon judging the speed of operation of the steering wheel, to switch the flow passage in the control valve of the actuator such that the rear wheel steer angle is generated in the direction counter to the front wheels and in the same direction as the front wheels, respectively, when the steering wheel is being operated quickly and gently. In consequence, the hydraulic pressure generated in the hydraulic pressure generator driven by the engine is supplied to and discharged from two chambers in the piston, respectively. The two chambers in the cylinder are separated from each other by the piston to which is fixed the linkage which in turn is connected to the rear wheels. Therefore, the rear wheels are steered by the linkage which is moved by the movement of the piston caused by the pressure differential across the piston. When the rear wheel steer angle is generated in the direction counter to the front wheels, front wheel steer angle and the rear wheel steer angle are generated substantially concurrently so that the front and rear wheels produce respective forces. These forces in combination produce a yawing moment which tends to turn the vehicle in one direction, thus producing an effect equivalent to that attained by an increase in the steering gain which is the ratio of angle of steer of the steerable wheel to the angular displacement of the steering wheel. Namely, in this case, the effective steer angle of wheels of the vehicle is considered equivalent to the sum of the front wheel steer angle and the rear wheel steer angle, so that the response to the steering input is improved remarkably. Conversely, when the rear wheel steer angle is generated in the same direction as the front wheels, the effective steer angle of the steerable wheels of the vehicle is equivalent to the difference between the steer angles of the front and rear wheels, so that the steering gain is decreased to provide a higher steering stability during straight running of the vehicle.

Detailed Description Text (68):
As will be understood from the foregoing description, according to the third embodiment of the invention, the rear wheel steer angle is formed in the direction counter to the direction of steer of the front wheels when the vehicle is running

at low speed, thus improving the turning performance of the vehicle, whereas, when the vehicle is running at high speed, the rear wheels are steered in the same direction as the front wheels thus avoiding any drastic increase in the turning sensitivity of the vehicle, thereby assuring a high steering stability. In addition, when the vehicle is running at a medium speed, the direction of steer of the rear wheels is controlled in accordance with the speed of operation of the steering wheel, such that the steering gain is increased to improve the response to the steering input for turning the vehicle when the steering wheel is being operated quickly, whereas, when the steering wheel is being operated slowly, the steering gain is decreased to prevent yaw and fluctuation of the vehicle thereby attaining a high running stability during straight running of the vehicle.

Detailed Description Text (69):
A steering operation during running at high speed causes a large yaw rate, as well as a large lateral acceleration. It is, therefore, possible to control the cross-sectional area of the orifice by making use of the yaw rate or the lateral acceleration as the physical amount relating to the vehicle speed, in place of the vehicle velocity explained before. FIG. 10A shows an example of a yaw rate detector which is used for the purpose of detection of the yaw rate. As will be seen from this Figure, the yaw rate detector is composed of a rate gyro 251 and an electric system 252. The rate gyro 251 is fixed to the chassis 30 at a position of centroid of the latter and is designed for detecting the yaw rate r which is the angular velocity of the vehicle body 30 about a vertical axis. The electric system 252 is adapted to supply a voltage to the rate gyro 251 and to produce a yaw rate signal by amplifying the signal from the rate gyro 251. The yaw rate signal is delivered to the microcomputer 130 as shown in FIG. 8A. The rate gyro 251 and the electric system 252 are arranged such that the yaw rate signal takes a positive value when the yaw rate r is produced by clockwise yaw of the vehicle about a vertical axis in response to clockwise rotation of the steering wheel 1, and a negative value when the yaw rate r is produced by counter-clockwise yaw of the vehicle about the vertical axis in response to counter-clockwise rotation of the steering wheel 1, as shown in FIG. 10B. The microcomputer 130 operates to maximize and minimize the cross-sectional area of the orifice when the absolute value of the yaw rate signal is large and small, respectively, whereby the steer angle of the rear wheel is controlled as in the case of the second embodiment.

Detailed Description Text (169):
Thus, in this ninth embodiment of the invention, the rear wheel steer angle is formed in the counter direction to the direction of steer of the front wheels such as to improve the turning performance of the vehicle whenever the vehicle is running at low speed, whereas, when the vehicle is running at high speed, the rear wheel steer angle is formed in the same direction as the front wheels such as to prevent any drastic increase of the sensitivity to the turning steering input, thereby improving the steering stability. On the other hand, when the vehicle is running at medium speed, the direction of the rear wheel steer angle is controlled in accordance with the speed of rotation of the steering wheel such that, when the steering wheel is being operated quickly, the steering gain is increased to improve the response to the steering input for quick turning of the vehicle, while, when the steering wheel is being operated slowly, the steering gain is decreased to prevent the yaw and fluctuation of the vehicle thereby improving the running stability during straight running of the vehicle.

CLAIMS:

18. An apparatus for controlling steer angle of rear wheels of a vehicle according to claim 14, wherein said physical amount is a yaw rate or a lateral acceleration of said vehicle.

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L8: Entry 4 of 5 File: USPT Jan 19, 1988

US-PAT-NO: 4720790
DOCUMENT-IDENTIFIER: US 4720790 A

TITLE: Apparatus for controlling steer angle of rear wheels of vehicle

DATE-ISSUED: January 19, 1988

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
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Fukui; Katsuhiko	Nagoya			JP
Hayashi; Yasutaka	Seto			JP
Ishiguro; Michio	Toyota			JP

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
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DATE FILED: May 15, 1985

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
JP	59-102202	May 21, 1984
JP	59-163428	August 2, 1984

INT-CL: [04] B62D 5/06

US-CL-ISSUED: 364/424; 180/140, 180/142, 280/91
US-CL-CURRENT: 701/41; 180/415

FIELD-OF-SEARCH: 364/559, 364/424, 364/426, 180/140, 180/142, 180/143, 180/79.1, 280/91

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	4418780	December 1983	Ito et al.	180/142

☐	4441572	April 1984	Ito et al.	180/140
☐	4522417	June 1985	Sano et al.	280/91
☐	4527654	July 1985	Shibahata et al.	180/140
☐	4552239	November 1985	Kanazawa et al.	180/140
☐	4566710	January 1986	Furukawa et al.	180/140 X
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☐	4597462	July 1986	Sano et al.	180/140
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FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
0150858	August 1985	EP	180/140
0165706	December 1985	EP	
0044568	March 1982	JP	

ART-UNIT: 234

PRIMARY-EXAMINER: Lall; Parshotam S.

ASSISTANT-EXAMINER: Black; Thomas G.

ATTY-AGENT-FIRM: Parkhurst & Oliff

ABSTRACT:

A rear wheel steer angle controlling apparatus for vehicles having steerable front and rear wheels, adapted for controlling the steer angle of rear wheels in response to the operation of the steering wheel for steering the front wheels. When the steering wheel is operated quickly, a rear wheel steer angle is formed in the counter direction to the direction of the front wheel steer angle, so that the response to the steering input for turning the vehicle is improved. Conversely, when the steering wheel is operated slowly, a rear wheel steer angle is formed in the same direction as the front wheel steer angle, thus enhancing the stability of the vehicle running straight. When the vehicle is running at a high speed, the rear wheel steer angle is formed always in the same direction as the front wheel steer angle regardless of the speed of operation of the steering wheel, so that the steering stability during high speed running is improved. When a yawing moment is generated due to a disturbance such as lateral wind, the rear wheel steer angle is automatically controlled in such a manner as to negate the yawing moment, thus compensating for the lateral displacement of the vehicle without requiring correcting steering operation by the driver.

35 Claims, 39 Drawing figures

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L8: Entry 4 of 5 File: USPT Jan 19, 1988

DOCUMENT-IDENTIFIER: US 4720790 A
TITLE: Apparatus for controlling steer angle of rear wheels of vehicle

Detailed Description Text (238):
As will be seen from FIG. 16A, the yaw rate detector II.sub.B has a rate gyro 1251 and an electric system 1252. The rate gyro 1251 is fixed to the centroid position of the vehicle chassis 15 and is adapted to detect the angular velocity (yaw angular velocity or rate) of rotation of the chassis about a vertical axis. The electric system supplies the rate gyro with electric voltage and amplifies the output signal from the rate gyro 1251 thus forming and delivering a yaw rate signal to the multiplier amplifier circuit III.sub.B of the signal processing circuit III. The yaw rate signal takes the form of a positive voltage signal when the vehicle turns clockwise about the vertical axis in response to clockwise rotation of the steering wheel 1, and the form of a negative voltage when the vehicle turns counter-clockwise about the vertical axis in response to the counter-clockwise rotation of the steering wheel 1. Thus, the polarity of the yaw rate signal is determined by the rate gyro 1251 and the electric system 1252. The yaw rate signal is formed not only when the vehicle is turned intentionally in response to the steering operation but also when the vehicle is turned by an external disturbance. The relationship between the turning direction and the polarity of the yaw rate is the same as that in the case of the intentional turning in response to the steering operation.

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